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OPERATION OF SOVIET 3D6 SHIP DIESELS

In 1948, the Neman Ship Line started using 3D6 diesel engines in its passenger, freight, transit, and roadstead vessels. At present, ships equipped with these engines are operating in sea harbors and in the upper reaches of rivers where the minimum depth of the water averages 50 centimeters.

When the first 3D6 diesels were put in operation, the ship line workers were not well acquainted with the engine's peculiarities and there were cases of engine breakdown through disrepair of electrical equipment and the cooling and lubricating systems.

The first 3D6 diesels produced were guaranteed by the producer to run only 1,000 hours before major overhaul, and they were very difficult to operate. Many workers of the operational services of the ship line were therefore skeptical about developing the engine for wide use in the fleet. They thought the engine too unreliable and expected repair costs to be heavy. This skepticism was substantiated by the fact that foreign-made diesels were also unreliable, repairs were complicated, and it was difficult to operate the engines even the specified 1,500-2,000 hours between major overhauls. Between 1947 and 1948, the ship line had in operation more than 30 types of low and high rpm engines, including US, British, French, German, Belgian, Japanese, Soviet, and other makes. Normal operations were impossible under these conditions, so the ship line turned to the Soviet-made 3D6 diesel for its standard engine.

The ship line used trained men (special courses of 250-400 hours were given by the ship line) to operate and maintain the engines. A diesel shop was built in the Kaunas Ship Repair Plant for the assembly and repair of the engine.

After a season of operation, ships equipped with the 3D6 engines were sent to the Kaunas plant for repair. When engines which had run the specified time (1,500 hours) were dismantled for repair, it was found that little wear had occurred in the engine parts and therefore only piston rings and, at times, bearings had to be replaced. It became evident that the 3D6 engine could operate 3,000-4,000 hours between major overhauls. Norms for operating the engine were

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established by ship-machinery services in cooperation with the diesel plant. They called for piston ring replacement and engine overhaul only after special inspection by a special engine commission. At the same time, the engine's cooling and lubricating systems were improved and several workers' suggestions for improving the water pump and reducer gear lubrication, for improving the electrical equipment, etc., were introduced.

During the 1949 navigation season, several engines had to be sent to the plant for repair because of faulty assembly of the cooling and lubricating systems. When the engines, which had been operated more than 3,500 hours, were inspected, no excessive wear, cracks, fissures, or coloring of the case-hardened layer were found, and only work which resulted from damage (grinding the crankshaft, replacing bearings because of the scoring of the bearings by sand) had to be done.

In 1949, the engineer of the diesel ship Michurin managed to run his 3D6 diesel 4,520 hours without stopping for engine overhaul. This was accomplished by improving the cooling and lubrication systems, by installing additional filters in the fuel tank and in the through-the-hull connection, and by cleaning the filters frequently. A viscosity meter and piezometer were used to check the fuel quality. The ship's storage batteries were kept in use for three full navigation seasons. The condition of the engine after 4,520 hours of operation is indicated in the following chart:

Engine Time	Oil Pressure (in atm)	Underpressure in Crankcase (in mm of water column)
0	8.5	15
2,000	8.0	12
3,000	7.6	9
4,000	7.2	6

(safe oil pressure, 6-9 atmospheres; safe pressure in crankcase, 50 mm of water column)

Other ships of the Neman Ship Line scored successes with the 3D6 diesel engine. On the Ostrovskiy, the engine was run 5,157 hours before major overhaul, on the Nekrasov 5,100 hours, and on the Dzhugas more than 6,000 hours. The following two tables indicate the amount of wear on engine No 710k-2295-211 of the Ostrovskiy after 5,157 hours of operation (in millimeters).

Type Wear	Journal Number (counting from transmission)						
	1	2	3	4	5	6	7
	Crank Pins						
Elliptical	0.01	0.02	0.01	0.02	0.01	0.01	0.01
Conical	0.01	0.00	0.02	0.00	0.00	0.01	0.00
Over-all	0.01	--	--	0.04	--	--	0.01
	Crank Journals						
Elliptical	0.02	0.01	0.01	0.01	0.01	0.00	--
Conical	0.01	0.00	0.01	0.01	0.01	0.00	--

(Measurements are made at three places on each journal. Figures in the table represent the worst of the three readings.)

Diameter of the first six crank pins was 94.87 by 94.80 millimeters; of the seventh, 94.90 by 94.87 millimeters (original diameter is 94.92 millimeters). Diameter of the crank journals was 84.88 by 84.84 millimeters (original diameter 84.92).

The clearance between the crankshaft journals and the bearings was:

Crank pin bearings No 1-6	0.12 - 0.20 mm
Crank pin bearing No 7	0.10 - 0.12 mm
Crankshaft journal bearings	0.12 - 0.15 mm

(0.22 mm clearance permissible)

The opening of the oil hole of the crankshaft was, in some cases, plugged in a semicircular manner to one third its diameter.

Cylinder Liners

	Number of Cylinder (counting from transmission side)					
	1	2	3	4	5	6
	Sleeve Wear (mm)					
Upper	0.01	0.10	0.09	0.05	0.08	0.05
Lower	0.04	0.12	0.04	0.01	0.07	0.01

Diameter of the cylinder liners was 150.01 by 150.08 millimeters. Up to 0.06 millimeter wear was found on the pistons. The gap between the cylinder liners and pistons was from 0.48 to 0.69 millimeter (normal is 0.45 to 0.54 with a maximum gap of 0.90 millimeter permissible). Oil pressure in both engines was less than 6 atmospheres at operating temperatures of 80-85 degrees centigrade.

After experimenting with twenty-five 3D6 engines for two seasons, it was decided that preventative repairs should be performed at the following times: Repair No 1, after 100 hours of operation; No 2, after 500; No 3, after 3,000; and No 4, after 5,000.

Repair No 3 calls for piston ring replacement, valve grinding, and removal of crankshaft for the purpose of cleaning out the oil channels. Bearings are not changed in this repair.

Both line and group mechanics were made responsible for making periodic engine inspection. Special attention was paid to the maintenance of the fuel burners, fuel pumps, outlet and intake engine valves, lubrication and cooling systems, reverse reducer gear, and electrical equipment.

At the same time, several improvements were made in the cooling and lubricating systems. The tube diameters were increased 35-40 millimeters, stopcocks were replaced, filters were improved, and larger tanks were installed. In many ships, the engine beds were reinforced to avoid breakage of the crankshaft and crankcase.

By carefully observing the instructions for operating the 3D6 diesel engine, the crew of the shallow draft tug Tolbukhin operated the engine 5,200 hours during more than 2½ navigation seasons without committing the engine to the plant for repairs. When the engine and auxiliary equipment were then inspected by a special engine-inspecting commission, and were still found to be in good condition, the crew of the Tolbukhin pledged to operate the ship 10,000 hours without stopping for plant repairs. At the end of the 1951 navigation season, they have succeeded in operating the engine 7,244 hours without plant repair; since inspection proved that the engine was still in good repair, the engine was laid up for the winter season without being sent to the plant for major overhaul. During the 1951 season, the Tolbukhin completed its hauling plan 127 percent, saved 10 percent fuel and 15 percent lubricants above plan, and saved 72,000 rubles as a result of eliminating plant repair. (At the time the ship was laid up, the oil pressure of the 3D6 engine was 8 atmospheres, and the underpressure in the crankcase was 7 millimeters of water column.)

The engine crew on the ship Tolbukhin serviced its 3D6 engine in the following way:

1. During the first 20 minutes of operation when the oil and water temperatures did not exceed 55 degrees centigrade, the engine was operated at 650-700 rpm.

When the engine was under load, water and oil temperatures were maintained at 80-85 degrees centigrade. This guaranteed complete burning of fuel and, at this temperature, the piston rings and bearings did not burn or coke up, and the exhaust collector did not foul. Motor efficiency was increased. Before the engine was stopped, water and oil temperatures were lowered to 50-55 degrees centigrade.

2. The diesel fuel was cleaned by a silk filter. Fuel filters were cleaned every 50 hours and sediment was drained from the fuel tanks regularly. An auxiliary Kemaf-type filter was installed on the fuel line.

3. Special apparatus was obtained for testing the fuel jets, which were checked every 800-1,000 hours of engine operation. The fuel pump did not require repair but was checked and regulated for uniform fuel supply.

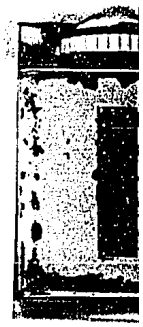
4. Oil was filtered through a screen filter. A supplementary filter (screen No 60) was installed in the system to assure better lubrication, and the oil filters were cleaned every 50 hours. Every 500 hours, the line leading to the oil filter was cleaned and the service tank was checked carefully to make sure no sediment or water accumulated.

Oil was changed every 100 hours. However, after engine break-in, it was filtered through felt at 80-85 degrees temperature. After it had stood for 12-15 hours, the oil was checked by the viscosity meter and, if still good, was used a second time. In 1951, this process accounted for a saving of nearly one ton of aircraft oil.

5. The oil breather was kept clean to prevent pressure building up in the crankcase.

6. Small copper screens were used to filter the cooling water. This eliminated sand, saving wear on the water pump and keeping the cooling system clear.

7. Every 500 hours, the water jacket was cleaned with sodium bichromate. Water filters were cleaned every 60-70 hours and the cooling system every 500 hours.



8. To avoid premature wear of the reverse reducer gear, shifting was carried out swiftly and smoothly. The engine was kept carefully aligned. The oil in the oil bath of the reducer gear was always kept at normal level and no oil was allowed to enter the friction clutch housing. The latter was cleaned frequently with gas oil. Shaft bearings of the forward and reverse gears were lubricated after 80 hours of operation, the collar after 50 hours.

When the pressure spring of the cam shaft drive was weakened after long engine operation, the mechanism (ferrado) would slip or break. Although this was usually regulated at the plant, the crew made a special key which enabled them to do this work in 2 or 3 hours.

9. Much attention was paid to electrical equipment. Distilled water was always kept on board and batteries were kept full. An areometer was used to check the density of the electrolyte. To increase the life of the generator, the shunting line from the relay was opened during the day and the dynamo was operated without a load.

Although the Tolbukhin had operated 7,244 hours it was not necessary to change piston rings, the head ports had not carboned up, and all overhead apparatus, the reverse reducer gear, and batteries were in good condition.

Other ships of the Neman Ship Line are trying to follow the good example set by the diesel ship Tolbukhin and are pledging to operate their 3D6 diesel engines 10,000 miles before committing them to plant repair.

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